

NEW SPECIES OF *PHAEDRANASSA* AND *EUCHARIS* (AMARYLLIDACEAE)¹

ALAN W. MEEROW

Horticultural Systematics Laboratory
Department of Ornamental Horticulture
University of Florida, Gainesville, FL 32611, U.S.A.

ABSTRACT

Phaedranassa brevifolia is described from Ecuador. Chromosome number of *P. brevifolia* is $2n = 46$, as has been reported for other species of the genus. *Eucharis moorei*, *E. cyaneosperma*, and *E. formosa* are described from Ecuador and Amazonian Peru and Colombia. *Eucharis moorei* is putatively the most primitive species in the genus, with many ancestral characters of the genus. All three *Eucharis* species have a chromosome number of $2n = 46$, the most common somatic number in the genus. Karyotypic differences between Peruvian and Ecuadorean *E. formosa* are reported.

Monographic and floristic work on Andean Amaryllidaceae of "infrafamily" Pancratioidinae (sensu Traub 1957, 1963) has necessitated recognition of the following new species in *Phaedranassa* Herbert and *Eucharis* Planchon & Linden.

MATERIALS AND METHODS

Root tips for karyotype analysis were pretreated for 2 hours at room temperature in a 10 ppm solution of o-isopropyl-N-phenylcarbamate (Storey and Mann 1967), fixed in a 3:1 mixture of 95% EtOH at 18° C for 24 hours, and subsequently stored in 70% EtOH at 18° C. Root tips were hydrolized in 1N HCL at 50° C for 2 – 3 minutes, squashed, and stained with iron aceto-carmine. As absolute chromosome length can vary appreciably from cell to cell due to differential affects of pre-treatment (Tjio and Hagberg 1951; Schlarbaum and Tscuchiya 1984), relative length, based on a value of 100 for the haploid complement, was used to designate size class. Relative size classes are based on 80% or better correlations between absolute size class (modified from Battaglia, 1955) and relative length (RL) of mitotic metaphase preparations of various species of *Eucharis*, *Eucrosia*, *Phaedranassa*, and other Amaryllidaceae with $2n = 46$, all of which have similar relative length ranges. $RL \geq 7.0$ [absolute length (AL): $> 10 \mu\text{m}$] = large, $5.0 - 7.0$ (AL: $7 - 10 \mu\text{m}$) = moderately large, $3.5 - 5.0$ (AL: $5 - 7 \mu\text{m}$) = medium, ≤ 3.5 (AL: $2 - 5 \mu\text{m}$) = small. Chromosome

¹This paper is Florida Agricultural Experiment Station Journal Series No. 5369.

morphology, modified from Battaglia (1955), is defined as follows: metacentric, Arm Ratio (AR; long arm/short arm) = 1.00 – 1.10; nearmetacentric, AR = 1.10 – 1.50; submetacentric, AR = 1.50 – 3.00; subtelocentric, AR = > 3.00.

Leaf samples were fixed in FAA, treated for, and examined with scanning electron microscopy as reported for fresh pollen in Meerow and Dehgan (1985).

A NEW SPECIES OF PHAEDRANASSA

Phaedranassa is a small, primarily Ecuadorean genus closely allied to *Eucrosia* Ker-Gawler, *Raubia* Traub, and, more distantly, to *Stenomesson* Herbert (Meerow 1987). Species delimitation within *Phaedranassa* is frequently cryptic, and almost completely obscured in herbarium specimens. Foliage characters often provide important indicators for species delimitation, yet leaves of most species are hysteranthous, and therefore usually absent from dried collections. I have collected the genus widely in Ecuador in 1982 and again in 1984, and have also received living material from various colleagues. Comparative study of this material suggests that the following collection represents an undescribed species.

PHAEDRANASSA brevifolia Meerow, sp. nov. (Figure 1).

A *P. cinerea* Ravenna et *P. tunguraguae* Ravenna foliis minoribus et insigniter amphistomaticis, floribus paucioribus et brevioribus, perianthii tubo concolori, tepalis luteo-vittatis, et filamentis et stylo roseis differt.

Glabrous bulbous geophyte. Bulb sub-globose with a dark brown tunic, 3.5 – 4.5 × 4.5 – 5.5 cm; apical neck short, 13 – 20 mm long, 10 – 12 mm diam. Leaves 2, mostly hysteranthous, 1 sometimes present at anthesis, petiolate, non-glaucous; petiole sub-terete, 8.5 – 12 cm long, ca 3 – 4 mm thick; lamina narrowly elliptic, 13 – 16 cm long, 3 – 5 cm wide, apically short acuminate, basally attenuate to the petiole, dark green adaxially, whitish-green abaxially and densely striate (Figure 2), the striae more or less parallel, amphistomatic. Inflorescence umbellate, terminated by 2 lanceolate bracts which enclose the flowers before anthesis; scape terete, 39 – 56 cm tall, ca 6 mm diam. proximally, 2.2 – 3 mm distally, solid proximally, with a narrow diameter hollow cylinder in the distal half; bracts 23 – 28 mm long, ca 7 mm wide; inner bracteoles successively narrower and thinner. Flowers 5 – 7, funnelform to ventricose, declinate to sub-pendulous, pedicellate; pedicels 15 – 17 mm long; perianth 3.5 – 4 cm long, consisting of 6 tepals in two whorls basally connate into a short tube; tube sub-cylindrical, ca 7 mm long, pink, constricted at its juncture with the ovary, 2.8 mm at the base, 4.5 – 5.2 mm wide at the throat,

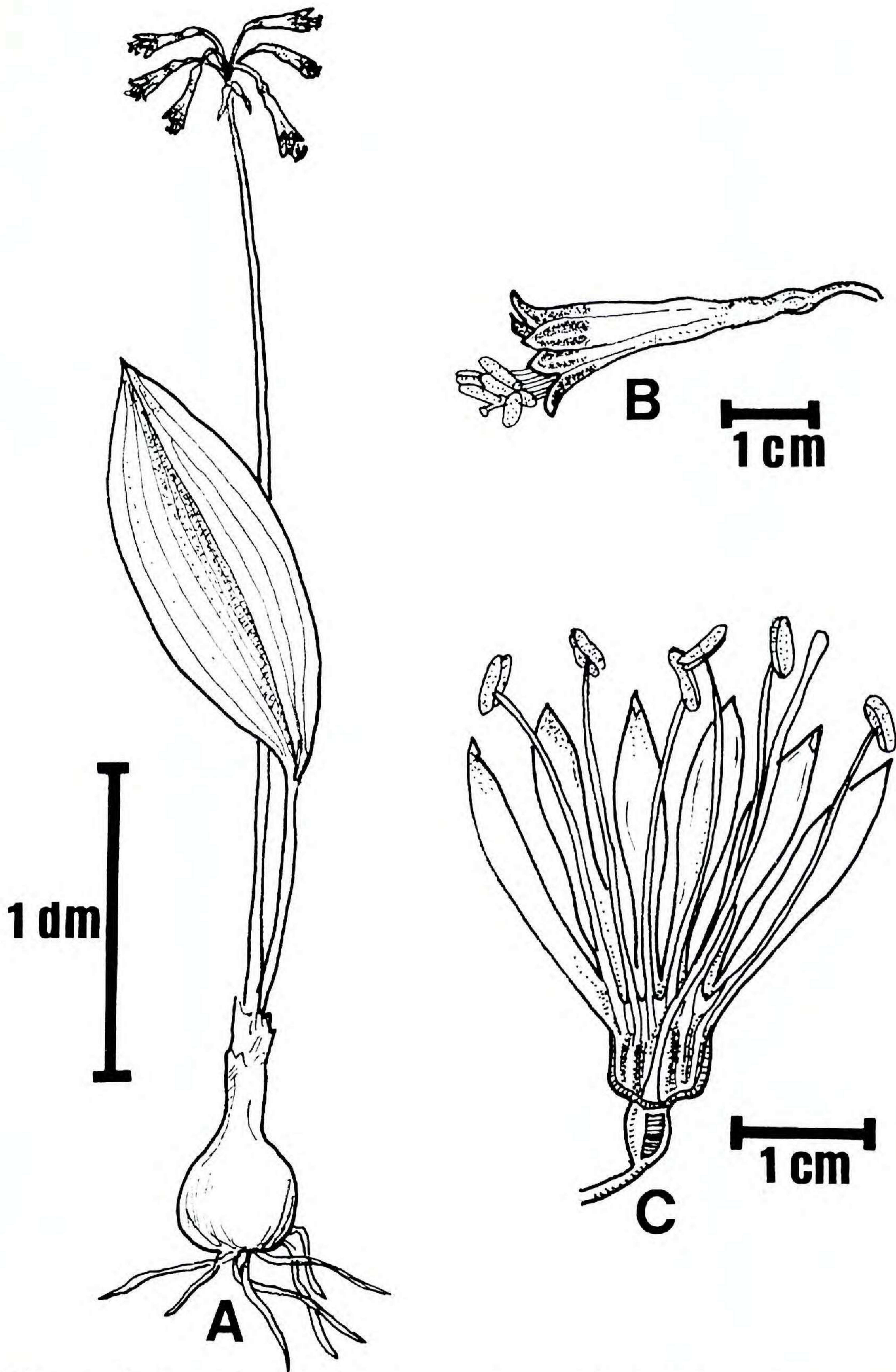


Figure 1. *Phaedranassa brevifolia*, after Madison *et al.* 4958 (SEL). A. Habit. B. Flower, lateral longitudinal view. C. Flower, dissected.

straight or slightly cernuous; tepals concrescent for most of their length, spreading distally to 9–12 mm, lanceolate, rose-pink with a yellow adaxial stripe, the apices light green with a pink (outer tepals) or white (inner tepals) hyaline margin; outer tepals 31–32 mm long, 4–4.5 mm wide with a green apiculum; inner tepals 29–30 mm long, 5–5.5 mm wide, acute. Stamens six, proximally fasciculate and closing off the perianth throat, free, exserted 2–3 mm from the perianth; filaments biseriate, the 3 opposite the inner tepals ca 26 mm long, 3 opposite outer tepals ca 29 mm long, filiform, pink; anthers oblong, ca 5 mm long, dorsifixed and versatile, introrse. Style ca 43 mm long, filiform, pink; stigma capitate, minute, less than 1 mm wide. Ovary oblong-ellipsoid, 5.5–6 mm long, 2.2–3.5 mm wide, green; ovules ca 20 in each locule, axile, biseriate, compressed. Fruit and seed unknown.

TYPE: ECUADOR. IMBABURA: Tercer Paso, on the San Lorenzo River, dry thorn scrub, 1100 m, 7 Jun 1978, *Madison et al.* 4958 (HOLOTYPE: F!; ISOTYPE: SEL!).

Previously, only two species of *Phaedranassa*, *P. tunguraguae* and *P. cinerea*, have been described from elevations below 2000 m. *Phaedranassa brevifolia* differs from *P. cinerea* by its small, non-glaucous leaves, from *P. tunguraguae* by its smaller leaves and flowers, and from both previously described species by its markedly amphistomatic leaves (adaxial stomata are rare on leaves of both *P. cinerea* and *P. tunguraguae*), fewer and smaller flowers, lighter green tepal apices, yellow stripe on the tepals, pink margins of the outer tepals (yellow in both *P. cinerea* and *P. tunguraguae*), and pink filaments and style. The three species each have distinctive abaxial leaf surface morphology (Figures 2–4). *Phaedranassa brevifolia* is a plant of xeric thorn scrub; *P. tunguraguae* and *P. cinerea* occur in steep, locally dry, open situations in moist montane forest. Like *P. tunguraguae* (Meerow 1985; Ravenna 1969), *P. brevifolia* is known only from the type locality (Figure 8).

The somatic chromosome number of *P. brevifolia* is $2n = 46$ (Figures 5–7A, Table 1), as has been previously reported for the genus (Brandham and Durodie 1981; Snoad 1952). This number is characteristic of most Neotropical genera of Amaryllidaceae “infrafamily” Pancratioidinae (Di Fulvio 1973; Flory 1977; Meerow 1986, 1987).

THREE NEW SPECIES OF EUCHARIS

Eucharis is genus of 16 species ranging from Guatemala to Bolivia (Meerow 1986). The plants are found in the understory of primary, rarely secondary, rainforest, but only in edaphic situations of high fertility. The plants do not tolerate high light levels, and are not able to recolonize readi-

TABLE 1. Karyotype data, *Phaedranassa brevifolia*, *Eucharis moorei*, *E. cyaneosperma*, and *E. formosa*. All vouchers deposited at FLAS unless otherwise stated.

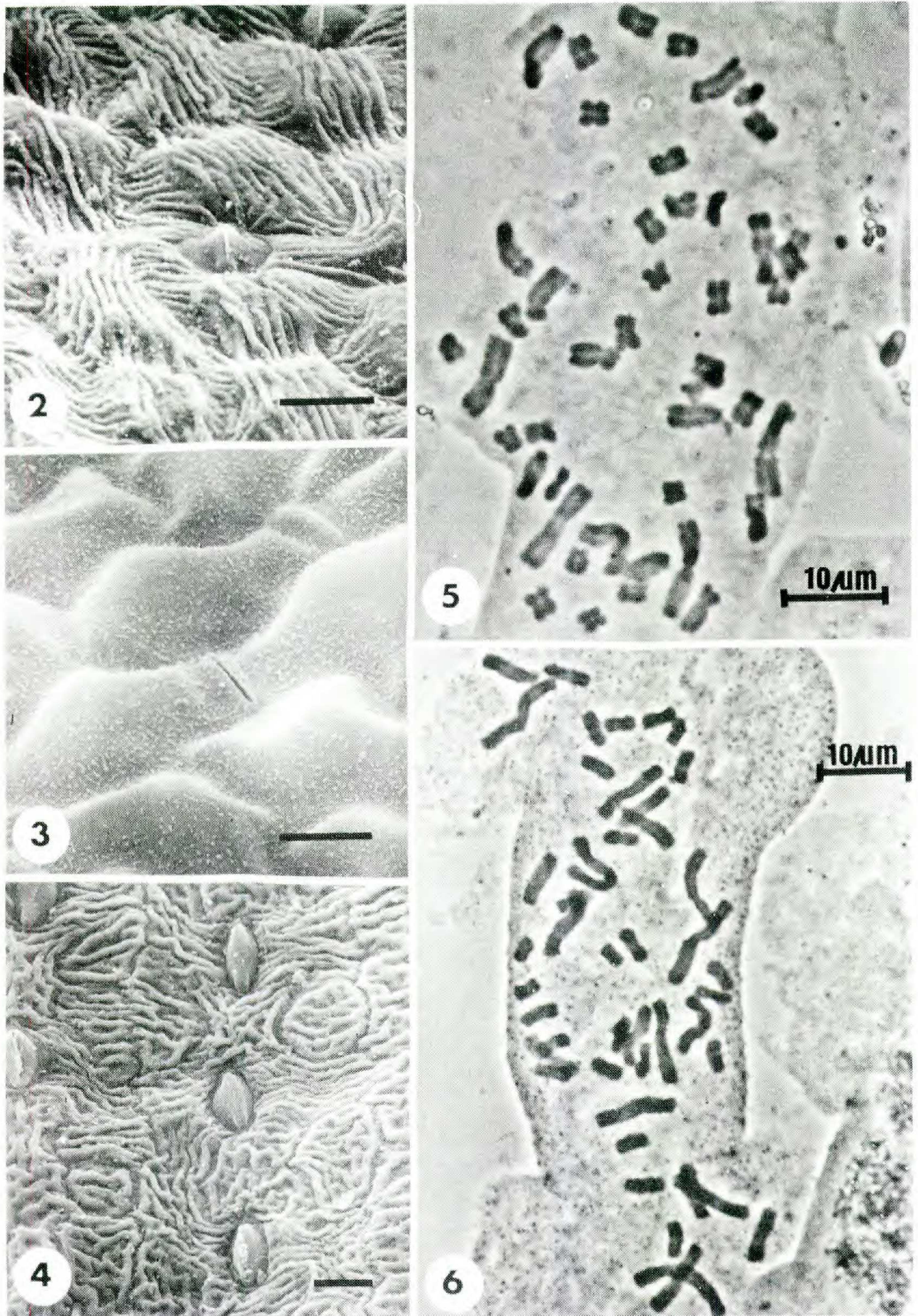
SPECIES, VOUCHER, 7 FIGURE NO.	2n	CHROMOSOME SIZE ^a RANGE (μm)	CHROMOSOME SIZE RANGE (relative length) ^b	CHROMOSOME SIZE ^c GROUPS L / ML / M / S	CHROMOSOME ^d MORPHOLOGY L / ML / M / S
<i>Phaedranassa brevifolia</i> (Madison et al. 4958, SEL) Figures 5-7A	46	2.5 – 10.4 (± 0.4) (± 1.4)	2.4 – 10.0 (± 0.3) (± 0.8)	4 10 8 24	m: 2 4 nm: 2 2 20 sm: 8 2 st: 2
<i>Eucharis moorei</i> (Meerow & Meerow 1141) Figures 7B, 11	46	2.6 – 13.5 (± 0.3) (± 0.9)	1.9 – 10.1 (± 0.2) (± 0.7)	6 8 6 26	m: 2 nm: 4 2 18 sm: 6 4 4 st: 2 2 t: 2
<i>E. cyaneosperma</i> Meerow 1032) Figures 7E, 12	46	3.9 – 16.7 (± 0.2) (± 1.4)	2.2 – 9.6 (± 0.2) (± 0.3)	6 6 14 20	m: 2 2 6 nm: 2 2 6 6 sm: 2 2 6 8 st: 2
<i>E. formosa</i> (Meerow 1099) Figures 7C, 13	46	2.6 – 14.2 (± 0.4) (± 1.9)	1.9 – 10.6 (± 0.3) (± 0.8)	4 10 6 26	m: 2 6 nm: 2 10 sm: 6 4 10
<i>E. formosa</i> (Schunke 14174) Figures 7D, 14	46	2.6 – 13.1 (± 0.5) (± 1.5)	2.1 – 10.5 (± 0.3) (± 0.5)	6 6 10 24	m: 4 4 nm: 14 sm: 2 4 6 st: 6 6

^amean of five cells

^bbased on a value of 100 for the haploid complement; mean of five cells

^cL = long, ML = moderately long, M = medium, S = small

^dm = metacentric, nm = near-metacentric, sm = submetacentric, st = subtelocentric, t = telocentric



Figures 2–6. 2–4. Scanning electron photomicrographs of abaxial leaf surfaces of *Phaedranassa* species. Scale bars = 50 μm . 2. *P. brevifolia* (Madison *et al.* 4958, SEL). 3. *P. cinerea* (Meerow & Meerow 1045, FLAS). 4. *P. tunguraguae* (Meerow & Meerow 1130, FLAS). 5–6. Root tip mitotic metaphase configurations of *Phaedranassa brevifolia* (Madison *et al.* 4958, SEL), $2n = 46$. Two chromosomes are outside the frame of Fig. 5.

ly after disturbance of the forest canopy. Consequently, the species are often rare or widely dispersed. The greatest concentration of species is in western, lowland Amazonas and the adjacent foothills of the central Andes. Two subgenera are recognized in the most recent revision of the genus (Meerow 1986); *Eucharis* (13 species) and *Heterocharis* Meerow (3 species). *Caliphruria* Herbert is recognized as a distinct genus in this treatment.

EUCHARIS moorei (Baker) Meerow, stat. nov., (subg. *Heterocharis*; Figures 9A – C, 10A, B). *Eucharis grandiflora* Planch. & Linden var. *moorei* Baker, Gard. Chron. 4:628. 1888. TYPE: *ex hort Glasnevin*, no other data, 1888 (HOLOTYPE: K!).

Evergreen bulbous geophyte. Bulb 6 – 7 cm long, 2.5 – 4 cm diam., tunics brown. Leaves persistent, 2 – 3; petiole 2 – 4 dm long, 5 – 7 mm thick, with an anomalous arc of secondary vascular bundles near the adaxial surface; lamina broadly ovate, length/width ratio less than or equal to 2, 17 – 30 cm long, 10 – 14 cm wide, apex shortly acuminate, base appearing cordate at the margins, coarsely undulate, lustrous dark green adaxially, lighter green abaxially, abaxial cuticle mostly without striations. Inflorescence scapose, umbellate, terminated by two marcescent, valvate-imbricate bracts that enclose the flowers before anthesis; scape 5 – 7 dm tall, terete, 7 – 10 mm diam. proximally, ca 5 mm diam. distally; bracts ovate-lanceolate, (25 –) 35 – 45 mm long, green. Flowers usually 4, rarely up to 7, more or less campanulate, declinate, sweetly fragrant; pedicels usually short, 3 – 10 (– 18) mm long; tube 40 – 52 mm long, cylindrical and 1.7 – 2 mm wide proximally, abruptly dilating at about its midpoint to (15.5 –) 18.5 – 25 mm at the throat, white except for a slight green tinge at the base; limb spreading less than 90° from the throat to ca 70 mm wide or less; tepals ovate, the margins undulate; outer series 3.3 – 4 cm long; 17 – 22 mm wide, apiculate; inner series 2.9 – 3.8 cm long, 22 – 27 mm wide, obtuse. Stamens 6, connate into a conspicuous staminal cup; cup cylindrical, (8 –) 10 – 15 (– 16.4) mm long (to apex of teeth), 20 – 25 mm wide, strongly recurved at the margins, white on the exterior, yellowish-green on the interior, shallowly and bidentate between each free filament, teeth acute, 2.5 – 3 mm long; each stamen ca 7 – 8 mm wide tooth-to-tooth; free filament subulate, (5 –) 6 – 8.5 mm long, 2 mm or less at the base; anthers 5.5 – 6.5 mm long, oblong-linear, greyish-brown; pollen grain ca 48.6 × 71.2 μm. Style 6 – 7 cm long; stigma 2.5 – 3.5 mm wide. Ovary ellipsoid-trigonous, (7 –) 10 – 13 mm long, ca 5 mm wide; ovules 16 – 20, biseriate. Capsule globose, ca 1.5 cm long, 1.3 cm wide, slightly rostellate, green, slightly glaucous; seeds 1 – 3 per locule, compressed globose, ca 6 mm diam., turgid, testa blackish-brown and rugose. $2n = 46$ (Figure 7B, 11)

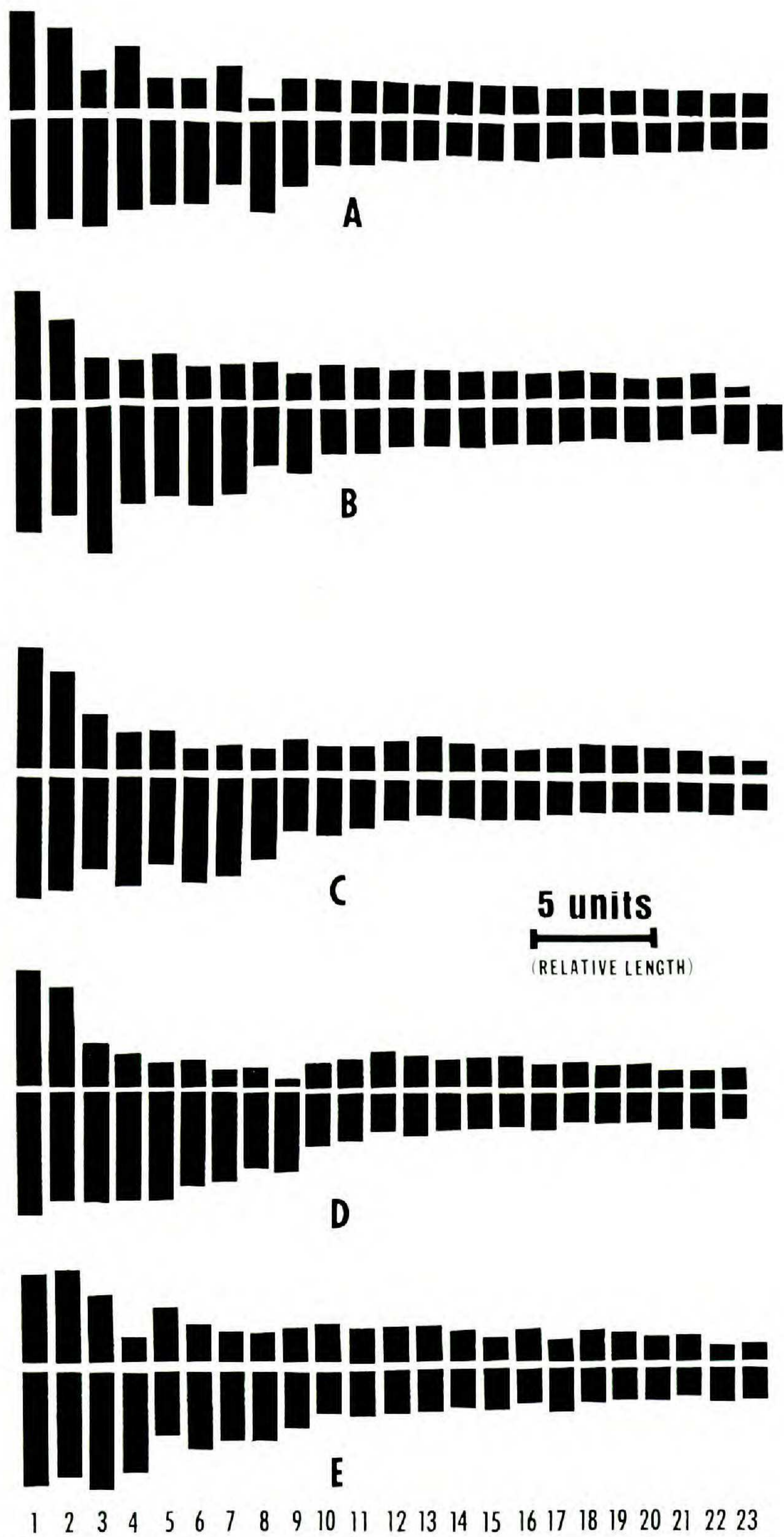


Figure 7. Haploid idiograms. A. *Phaedranassa brevifolia* (Madison *et al.* 4958). B. *Eucharis moorei* (Meerow & Meerow 1141, FLAS). C. *E. formosa* from Ecuador (Meerow 1099, FLAS). D. *E. formosa* from Peru (Schunke 14174, FLAS). E. *E. cyaneosperma* (Meerow *et al.* 1032, FLAS).

Distribution and ecology: An understory plant of primary and secondary lower montane rainforest of the Ecuadorean Andes, in Morona-Santiago and Santiago-Zamora Provinces on the east slopes, and Los Rios, Cotopaxi and contiguous Pichincha Provinces on the western declivity, (220 –) 600 – 1200 (– 2100) m; rare in the lower “ceja de montaña” of Cajamarca Department, Peru (Figure 15). Flowering is concentrated from January – March and again from (June –) July – September.

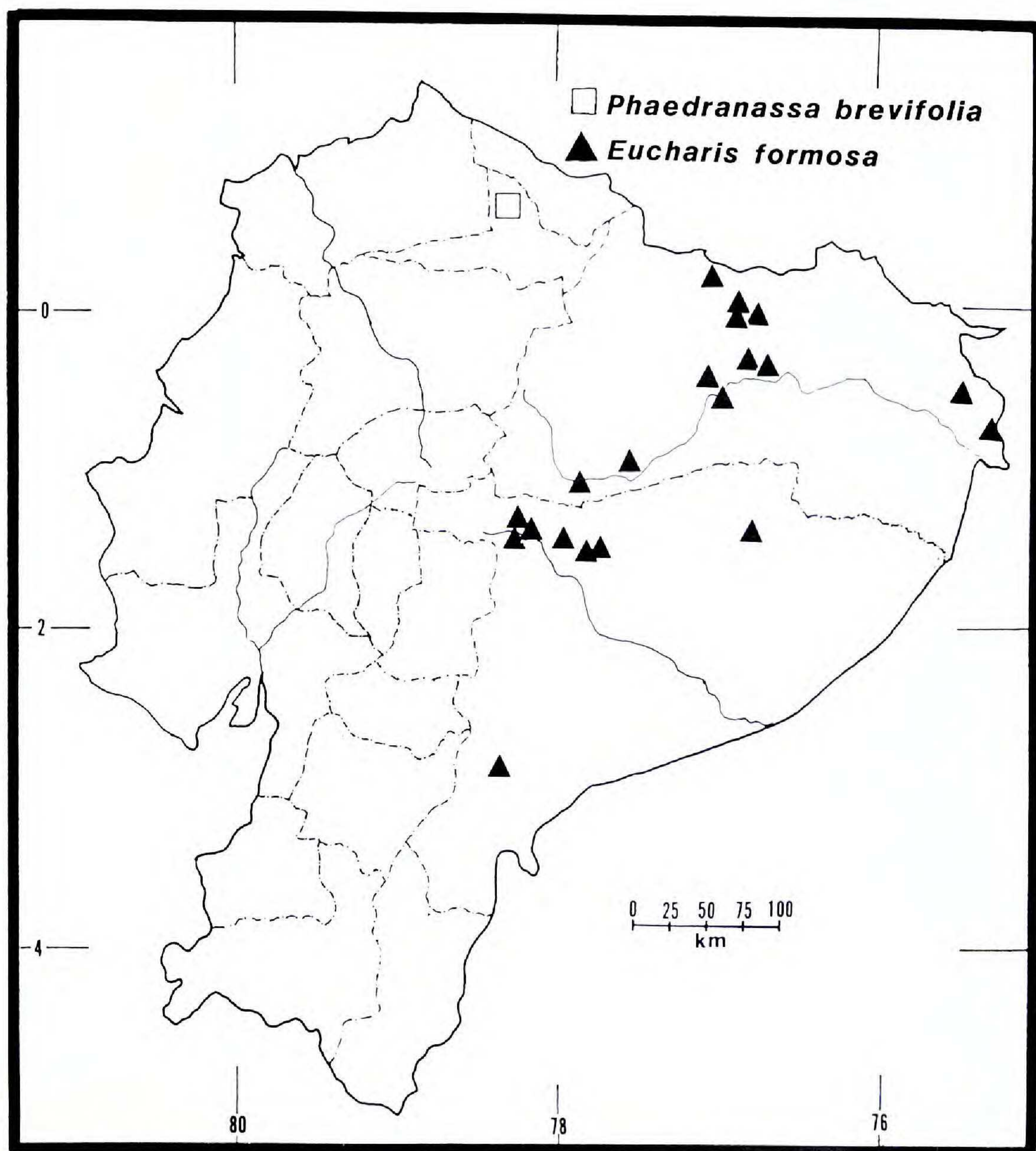


Figure 8. Distributions of *Phaedranassa brevifolia* and *Eucharis formosa* in Ecuador.

TABLE 2. Comparison of *Eucharis moorei* and *E. amazonica*.

CHARACTER	EUCHARIS MOOREI	EUCHARIS AMAZONICA
Leaf length/width ratio	< 2	> 2
Secondary petiolar bundles	conspicuous	reduced
Perianth morphology	campanulate	crateriform
Staminal cup dentation	acute	obtuse
Longest pollen grain equatorial diameter	71.2 μm	78.5 μm
Pollen stainability	100%	50–65%
Ovules per locule	16–20	9–12
Chromosome number ($2n$)	46	68
Distribution	Ecuador, on both sides of the Andes; rare in north central Peru	Peru, endemic to the middle Rio Huallaga valley

Additional material examined: ECUADOR. **Cotopaxi:** km 52–53 on rd from Quevedo to Latacunga, Río Pilalo, 800–950 m, 11 Aug 1984, *Meerow & Meerow 1137* (FLAS); same locality as preceding, 13 Aug 1984, *Meerow & Meerow 1141* (FLAS). **Los Rios:** km 56 Quevedo-Santo Domingo, Río Palenque Biological Station, 220 m, flowered in cultivation, *Dodson 5527* (SEL). **Morona-Santiago:** km 145, Cuenca-Gualaquiza, 1300 m, Jul 1982, *Dodson & Embree 13200* (MO, SEL); 27 km SE of San Juan Bosco, 1270 m, 27 Jan 1981, *Gentry et al. 30913* (MO, SEL); Indanza-Limón (General Plaza), 1300–1600 m, 23 Mar 1974, *Harling & Andersson 12779* (GB); Río Yunganza, rd Limón-Mendez (79°19'W, 2°49'S), 1100 m, 23 Sep 1979, *Holm-Nielsen et al. 20393 & 20407* (AAU); Río Gualaquiza and Río Bomboiza, east Andes of Sigsig, 800–1200 m, *Lehmann 5882* (K); 10–20 km from Gualaquiza on rd to Sigsig-Cuenca, 1300 m, 5 Aug 1984 *Meerow & Meerow 1135* (FLAS). **Pichincha:** Nanegal, west slope Andes, 5000 ft. *Jameson 9* (G, P). **Santiago-Zamora:** Yurupaza, 600 m, 3 Jun 1947, *Harling 1407* (GB); west side Río Valladolid, 2100–2400 m, 15 Oct 1943, *Steyermark 54717* (F). PERU. **Cajamarca:** Jaen, Río Tabaconas valley, 900–1000 m, May 1912, *Weberbauer 6251* (GH, US).

Herbarium material of *E. moorei*, when first received, was assigned to *E. amazonica* (Figures 10C, D). In 1984, I collected the species on both sides of the Ecuadorean Andes. Morphological and karyological differences between these collections and the Peruvian *E. amazonica* became evident (Table 2). *Eucharis moorei* is fully fertile, diploid ($2n = 46$) and of fairly wide distribution throughout Ecuador. An anomalous arc of secondary bundles appears in petiolar transverse sections of *E. moorei* and, reduced, in *E. amazonica* (Meerow 1986). These bundles are not found in any other species of the genus investigated. *Eucharis moorei* is putatively the most primitive species of the genus (Meerow 1986), with the greatest number of plesiomorphic character states in common with other genera of “infracfamily” Pancratioidinae (e.g., large, fragrant flower, short pedicels,

numerous ovules per locule). It is also one of only two *Eucharis* species that have telocentric chromosomes [Figure 7B, 11; the other species with telocentrics is *E. castelnaeana* (Baillon) Macbride of subg. *Eucharis* (Meerow 1986)]. Perianth and ovarian morphology of *E. moorei* is characteristic of *Eucharis* subg. *Heterocharis* Meerow, but the species has a conspicuous, long-exserted staminal cup as is characteristic of subg. *Eucharis*. The species also occupies a geographical position intermediate between *E. sanderi* (subg. *Heterocharis*), which is endemic to Chocó Department, Colombia, and the vast majority of subg. *Eucharis*. Species of subg. *Eucharis* are exceedingly rare on the western slopes of the Andes (Meerow 1986). *Eucharis moorei* is the only species in the genus that occurs on both sides of the Andes.

The presence of *E. moorei* in northwestern Ecuador, and the existence of putative natural hybrids between it and *E. sanderi* (*E. × grandiflora* Planchon & Linden), might suggest that it was this plant which Planchon and Linden (1853) described as *E. grandiflora* from the Chocó region of Colombia. To date, however, I have not seen a single collection of *E. moorei* from Colombia. All material from Chocó is referable to *E. sanderi* or the natural hybrid. Furthermore, the staminal cup of the flower illustrated in the lectotype of *E. × grandiflora* is clearly much shorter than that of *E. moorei*, and the general habit of the figured plant closely resembles *E. × grandiflora*.

EUCCHARIS cyaneosperma Meerow, sp. nov. (subg. *Eucharis*, Figure 9C, D).

Species a *E. ulei* Kranzl. affinis sed differt foliis ellipticis brevioribus, tubo minus arcuato, et testa seminali cobaltina.

Evergreen bulbous geophyte. Bulb subglobose, 3–5 cm long, 3–3.5 cm diam., tunics light brown. Leaves 2–4, persistent; petiole (10–) 15–30 (–35) cm long, 5–6.5 mm thick; lamina (ovate-) elliptic, 18–25 (–30) cm long, (6.5–) 7–8 (–12) cm wide, apically acute to shortly acuminate, attenuate at the base. Inflorescence scapose, umbellate, terminated by two marcescent, valvate-imbricate bracts that enclose the flowers before anthesis; scape (3–) 4–5 (–6.5) dm tall, 5–7 mm diam. proximally, 3–4 mm diam. distally; bracts ovate-lanceolate, (20–) 27–35 mm long. Flowers (3–) 5 (–7), pendent, without fragrance; pedicels (10–) 15–25 (–28) mm long, ca 1.7–2 mm diam.; tube 3–4 cm long, 1.5–2 mm diam. for most of its length, dilating abruptly to 7–9 mm proximal to the throat, curved abruptly ca 5 mm above the ovary then more or less straight; outer tepals 23–28 (–32) mm long, 8–10 (–13) mm wide, ovate-lanceolate, apiculate; inner tepals 21–24

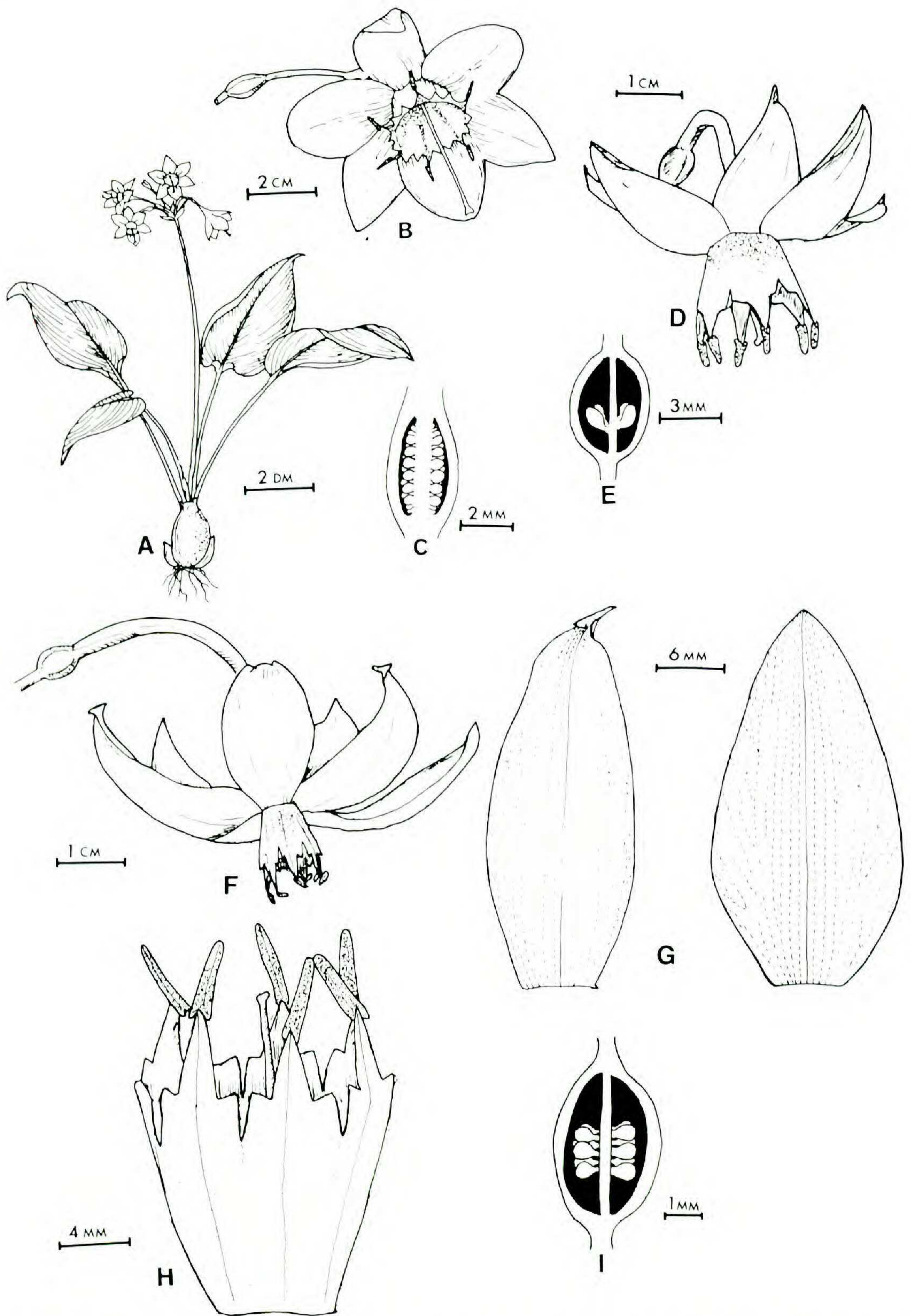


Figure 9. *Eucharis* species. A – C. *E. moorei* (after a drawing by Wendy B. Zomleffer of *Dodson 5527*, SEL). A. Habit. B. Flower. C. Longitudinal section of ovary. D – E. *E. cyaneosperma* (Meerow 1032, FLAS). D. Flower. E. Longitudinal section of ovary. F – I. *E. formosa* (Meerow 1099, FLAS). F. Flower. G. Tepals; outer (left), inner (right). H. Staminal cup. I. Longitudinal section of ovary.

(– 30) mm long, 10–14 (– 15) mm wide, ovate, acute to minutely apiculate. Staminal cup cylindrical, (8–) 10–12 mm long (to tooth or lobe), 10–13 (– 15) mm wide, pale yellow or green in the proximal third, quadrate or irregularly toothed between each free filament, the teeth when present less than 1.5 mm long, cleft between each stamen 2–3 mm deep; each stamen 3.5–4 (– 5) mm wide at the base; the narrow, subulate free filament (3–) 3.5–4.5 (– 5.5) mm long, ca 1.5 mm wide at the base; anthers ca 3 mm long, oblong; pollen grain ca $47.95 \times 67.55 \mu\text{m}$. Style 4.5–6 cm long, exerted 0.5–1 cm beyond the anthers; stigma 2–2.5 mm wide. Ovary sub-globose-trigonous, 5–7 mm long, 7–10 mm wide, usually wider than long; ovules 2 (– 3, 5) per locule, superposed in the lower half of the cell. Fruit a sub-globose, bright orange, leathery, triloculed, dehiscent capsule, 10–12 mm long, 15–20 mm wide; pedicel 25–36 mm long; seed ellipsoid, 7–9 mm long, ca 5 mm wide, with a lustrous, cobalt-blue testa. $2n = 46$ (Figure 7E, 12).

TYPE: PERU. SAN MARTÍN, 20 km north of Tocache Nuevo on road to Tarapoto, Río Cañuto, 520 m, 17 Jul 1982, *Meerow et al.* 1032 (holotype: FLAS!).

Distribution and ecology: Rare in the understory of pre- to lower montane rainforest of the Amazon basin and eastern Andean foothills, from Peru to Bolivia, (330–) 400–800 (– 1200) m elevation (Figure 15). Flowering at any time of the year but most commonly in August.

Additional material examined: BOLIVIA. El Beni: vicinity of Rurrenabague, 330 m, 25 Nov 1921, *Cardenas* 1179 (AA, NY, US); Rurrenabague, 500 m, 7 Oct 1921, *Cardenas* 1553A (NY); San Antonio, 15 Nov 1958, flowered in cultivation 30 Apr 1959, *Nelson* 58-301 (MO). BRAZIL. Acre: basin of Río Purus, near mouth of Río Macauhan, 9°20'S, 69°W, 17 Aug 1933, *Krukoff* 5573 (NY); Río Branco de Obidos, Santo Antonio, 6 Aug 1912, *Ducke* 12162 (GOEL, photo and fragment F). Amazonas: **Jurua Miry**, Jun 1901, *Ule* 5737b (B). PERU. Cuzco: Río Araza, northeast of Cuzco, 1150 m, Jan 1943, *Sandeman* 3724 (K, OXF). Loreto: lower Río Nanay, 24 May 1929, *Williams* 431 [in fruit] (F); La Victoria on Amazon, 21 Aug 1929, *Williams* 2619 [in fruit] (F); La Victoria on Amazon, 28 Aug 1929, *Williams* 2878 [in fruit] (F, US). Junin: Puerto Yessup, ca 400 m, 10–12 Jul 1929, *Killip & Smith* 26394 [in fruit] (F, NY, US); Río Negro to Satip, 800 m, 17 Aug 1960, *Woytkowski* 5830 (MO). San Martin: *Schunke* 4843 [in fruit] (F, US); Mariscal Caceres, Tocache Nuevo, Quebrada de Huaguisha, margen derecha del Río Huallaga, 400–450 m, 3 Jul 1974, *Schunke* 7146 [in fruit] (F). Ucayali: middle Ucayali, Cashiboplaya, 10°S, 1923, *Tessman* 3179 (G, NY, S).

Eucharis cyaneosperma is the only known species of *Eucharis* with blue-coated seeds. The species appears close to *E. ulei* in size, number of flowers, and ovule number, but differs by its usually shorter leaves, tube morphology, irregularly dentate to quadrate staminal cup (Figure 9C), and seed color. *Eucharis cyaneosperma* also occupies more upland sites than is usually characteristic of *E. ulei*. The species is nowhere abundant throughout its



Figure 10. A–B. *Eucharis moorei* (Meerow & Meerow 1141, FLAS). C–D. *E. amazonica* (Schunke 14179, FLAS).

broad range. Collections are concentrated in the southern end of the range of *E. cyaneosperma* (Figure 15), while *E. ulei* is more common to the north (Meerow 1986). The two species may represent sibling, allopatric divergences from a common ancestor that have since come into secondary contact.

EUCHARIS formosa Meerow, sp. nov. (subg. *Eucharis*, Figure 9F–I).

Eucharis candida Planchon et Linden primo aspectu maxime simile sed in omnes partes grandiores, floribus leniter fragrantibus, cupula staminea subcylindrica, et ovulis plerumque in quoque loculo plurimioribus; differt praecipue a *E. bakeriana* N.E. Brown cupula staminea angustiore inter stamina fissa profundius.

Evergreen bulbous geophyte to 6–8 dm tall. Bulb sub-globose, 4–7 cm long, 3–5 cm diam., neck 2–5 cm long, ca 1 cm thick, tunics brown. Leaves 1–2 (–3), persistent; petiole 25–38 (–42) cm long, 8.5–10 mm thick proximally, 5–6 mm thick distally; lamina elliptic, (21–) 30–45 (–52) cm long, (8–) 11–15 (–16) cm wide, usually conspicuously plicate, dark green and only slightly lustrous adaxially, light green abaxially, abaxial cuticle striate, margins coarsely undulate.

Inflorescence scapose, terminated by two marcescent, valvate-imbricate bracts; scape (5 –) 6 – 7 (– 8) dm tall, ca 1 cm diam. proximally, 5 – 6 mm diam. distally; bracts ovate-lanceolate, (36 –) 43 – 60 (– 85) mm long, 10 – 15 cm wide at the base. Flowers 8 – 10, very rarely less, pendent, emitting a mild, “sour” odor, crateriform; pedicels (8 –) 12 – 18 (– 30) mm long; tube 35 – 45 (– 50) mm long, ca 2 – 2.5 mm wide for most of its length, abruptly dilated to (9 –) 10 – 13 (– 14) mm at the throat; limb spreading to (55 –) 60 – 70 (– 80) cm; tepals sometimes recurved distally; outer tepals narrowly ovate, (30 –) 35 – 45 (– 47) mm long, (10 –) 15 – 18 (– 20) mm wide, apiculate, apiculum conspicuously horned adaxially (Ecuadorean populations); inner tepals ovate, (28 –) 32 – 40 (– 45) mm long, (15 –) 18 – 22 (– 25) mm wide, acute to minutely apiculate. Staminal cup funnelform-cylindrical, 10 – 13 (– 15) mm long (to apex of teeth or lobes), (15 –) 17 – 20 (– 22) mm wide; flushed greenish-yellow proximally, with the greatest concentration of pigment below each free filament, rarely only widely punctate; bidentate, irregularly toothed, lobed or quadrate between the distal portion of the filament; cup cleft between each stamen for 3 – 5 mm; teeth when present acute to obtuse, 2 mm or less long; each stamen (5 –) 6 – 7 (– 7.5) mm wide tooth-to-tooth or lobe-to-lobe; distal portion of filament subulate, (4.5 –) 5 – 6.6 (– 7) mm long, (1.8 –) 2 – 2.5 (– 3) mm wide at point of dilation; anthers oblong, 4.5 – 5.5 (– 6) mm long, grey-brown; pollen grain $47.7 - 53.4 \times 65.5 - 73.8 \mu\text{m}$. Style 5.5 – 6 (– 6.5) cm long, exerted ca 1 cm beyond the anthers; stigma ca 2 – 3 mm wide. Ovary globose-ellipsoid, 6 – 8.5 (– 10) mm long, (4.5 –) 5.5 – 7 (– 7.5) mm diam., green; ovules (2 – 3, 4 –) 5 – 7 (– 8). Fruit a sub-globose, bright orange, leathery, triloculed, dehiscent capsule, 1.5 – 2 cm long, 2 – 3 cm wide; pedicels 3 – 4 cm long; seeds (1 –) 2 – 4 per locule, ellipsoid, 8 – 10 mm long, 5 – 6 mm diam., with a lustrous, smooth black testa. $2n = 46$ (Figures 7C, D, 13, 14).

Distribution and ecology: Rich, moist soil in the understory of pre- and lower montane rainforest, chiefly in the Napo and Pastaza drainage of Ecuador (Figure 8); less frequent in Amazonian Peru and Colombia, the lower “ceja de montaña” of north central Peru, and upper Huallaga valley of Peru (Figure 15); rare in central Colombia [a single, poorly documented collection (*Killip s.n.*, COL) from near Popayan may be of cultivated origin], 100 – 1800 m; flowering most commonly January – March. A poultice of the bulbs is used to treat tumors (*Lawesson et al.* 39632); vernacular names: *cebolla de la selva*, *sugkip*.

TYPE: ECUADOR, MORONA-SANTIAGO, Road Limon-Macas, ca km 20 from Limon, primary rain forest and rastrojos, 700 – 900 m, 26 Mar 1974, *Harling & Andersson* 12915 (HOLOTYPE: GB!; ISOTYPE: FLAS!).

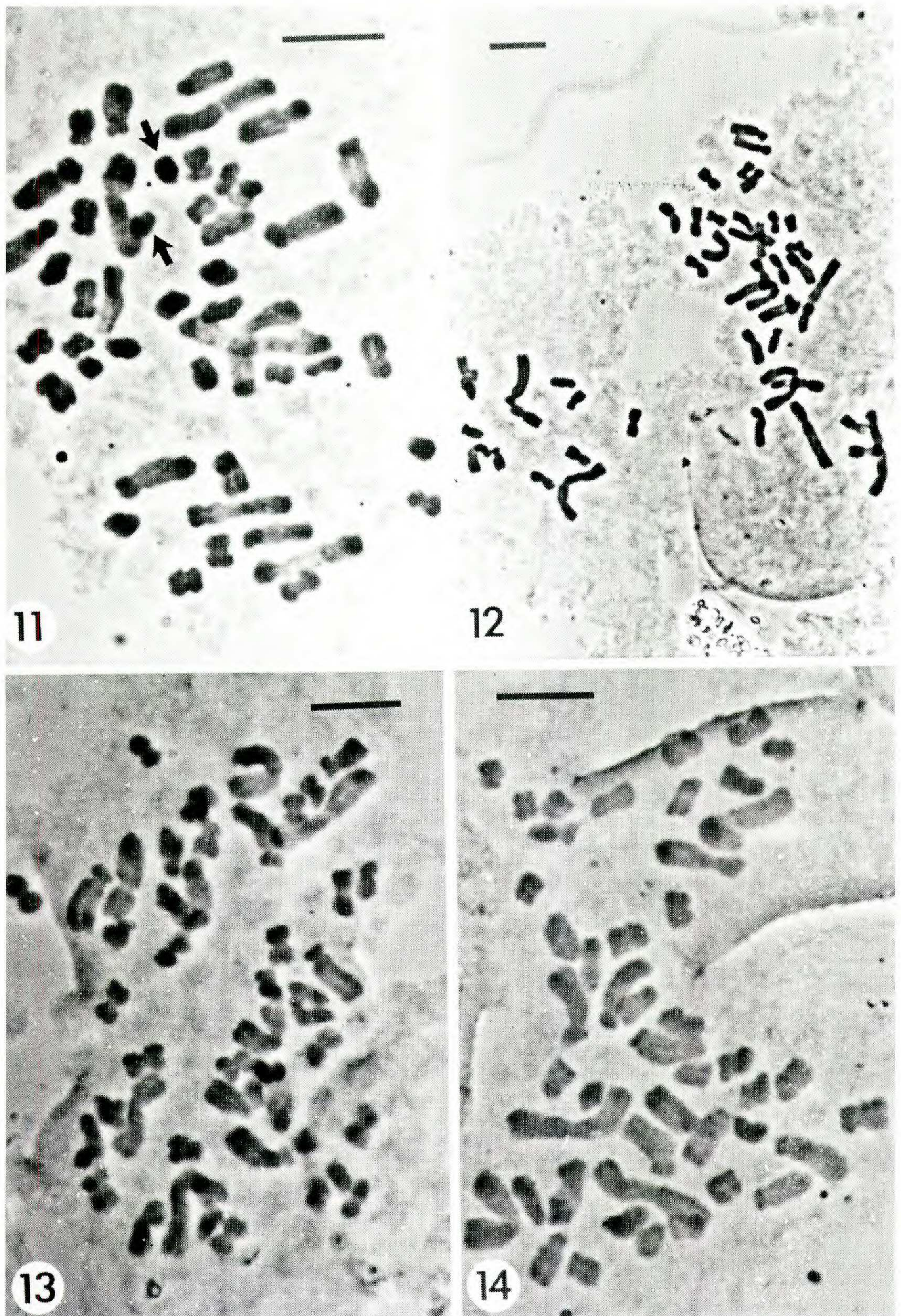


Figure 11 – 14. Root tip mitotic metaphase configurations of *Eucharis* species, all $2n = 46$. 11. *E. moorei* (Meerow & Meerow 1141, FLAS). Arrows indicate telocentric chromosomes. 12. *E. cyaneosperma* (Meerow 1032, FLAS). 13. *E. formosa* from Ecuador (Meerow 1099, FLAS). 14. *E. formosa* from Peru (Schunke 14174, FLAS). All scales = 10 μm .

Additional material examined: **COLOMBIA**. **Amazonas**: confluencia de los Ríos Amazonas y Loretoyacu, 12 Apr 1975, *Cabrera* 3336 (COL); Trapecio amazonico, Loretoyacu River, ca 100 m, Sep 1946, *Schultes & Black* 8342 [in fruit] (US); same locality as preceding, Oct 1946, *Schultes & Black* 8410 [in fruit] (GH, US). **Caqueta**: Morelia, 150 m, 5 Oct 1941, *von Sneidern s.n.* (S). **Cauca**: Popayan, no other data, 25 Jan 1935, *Killip s.n.* (COL). **ECUADOR**: **Napo**: Napo, forest, 6 Oct 1939, *Asplund* 9122 (S); Tena, marshy forest, 21 Oct 1939, *Asplund* 9488 (S); Limoncocha, 300 m, 22 Jan 1977, *Dodson* 6636 (SEL); 45 minute walk by trail from Santa Cecilia up Río Aguarico, ca 350 m, 28 Mar 1972, *Dwyer & MacBryde* 9699 [in fruit] (MO); Santa Cecilia, rainforest off runway, 340 m, 30 Mar 1972, *Dwyer & Simmons* 9743 [in fruit] (MO); Cañon de los Monos, ca 12 km north of Coca, 250 m, *Harling & Andersson* 11719, GB specimen (GB); path from Río Bueno to Santa Rosa, *Harling et al.* 7201 (GB); Río Jivino, Limoncocha, 13 – 15 Mar 1968, *Harling et al.* 7673 (FLAS, GB); Cañon de los Monos, road Coca-Lago Arrio, ca 12 km north of Coca, 24 Jan 1973, *Holguer* 2960 (GB); Santa Cecilia, Lago Agrio-Baeza, ca 16 km west of Lago Agrio, 27 Feb 1973, *Holguer* 3532 (FLAS, GB); Río Aguarico west of Detacamento Zancudo at entrance of Río Zancudo, 320 m, very rich soil, 29 Aug 1979, *Holm-Nielsen et al.* 20168 [in fruit] (AAU); Añangu, Río Napo, 76°23'W, 0°32'S, 260 – 350 m, 27 Jun 1983, *Lawesson et al.* 39632 (AAU); 4.2 – 7.5 km west of Lago Agrio (5 – 8.2 km east of Río Conejo) near Lago Agrio-Baeza Road, ca 340 m, 31 Mar 1972, *MacBryde & Dwyer* 1387 (MO); ex hort, voucher of SEL Acc. 78-1099, collected vicinity Limoncocha, 240 m, 15 Dec 1982, *Meerow* 1103 (FLAS). **Pastaza**: Mera, ca 1100 m, 3 Mar 1956, *Asplund* 19571 (S); Curaray (Jesús Pitishka), virgin rain forest near the posto militar, ca 200 m, 18 Mar 1980, *Harling & Andersson* 17374 (FLAS, GB); between Nalpi and Canelo, 26 Feb 1971, *Holguer* 1504 (FLAS, GB); trail from Indillama to Canelos, 400 m, occasional, 5 Feb 1935, *Mexia* 6855 (UC, US); on Napo road north of Puyo, 16 Feb 1953, *Prescott* 438 (NY). **TUNGURAHUA**: valley of Pastaza River, between Baños and Cashurco, 8 hours east of Baños, 1300 – 1800 m, *Hitchcock* 21891 (GH, NY, US); vicinity of Río Margarjitas on Canelos trail, 1225 m, 19 Mar 1939, *Penland & Summers* 142 (US). **PERU**. **Amazonas**: Quebrada Huampami, Lugar tseasim, monte al lado nayumpin, 800 ft, 3 Apr 1973, *Ancuash* 161 (MO); Quebrada de apigkagentsa, Río Cenepa, 720 ft, *Kayap* 597 (F, MO); Quebrada Cunup, monte cerca a la chacra, 800 – 850 ft, 24 Jul 1974, *Kayap* 1298 [in fruit] (MO); Río Cenepa, vicinity of Huampami, ca 5 km east of Chávez Valdía, ca 78°30'W, 4°30'S, Quebrada Aintami, 17 Aug 1978, *Kujikat* 415 (MO). **Loreto**: Maynas, Yanamono, Explorama Tourist Camp, Río Amazonas, between Indiana and mouth of Río Napo, 72°48'W, 3°28'S, 120 m, 18 Aug 1980, *Gentry et al.* 29867 (MO); same locality as preceding, 130 m, 18 Feb 1981, *Gentry et al.* 31418 (MO); Maynas, Iquitos, Río Ampiyacu, 4 vueltas de Monona Cocha, 4 Aug 1976, *Revilla* 990 (MO); Alto Amazonas, Yurimaguas, Camino a "Shunguyco," al sur-este de Puerto Arturo, cerca a Yurimaguas, 150 – 200 m, 1 Dec 1984, *Schunke* 14157 (FLAS). **San Martín**: Mariscal Caceres, Tocache Nuevo, Camino a Shunté, 12 Mar 1970, *Schunke* 3856 (F); Lamas, Alonso de Alvarado, Fundo Las Malvinas, carretera Moyobamba-Tarapoto, km 43, 850 m, 6 Dec 1984, *Schunke* 14174 (FLAS).

Eucharis formosa is the most commonly encountered species in eastern Ecuador. It extends into Amazonian Peru and Colombia, and also occurs in the lower "ceja de montaña" forests of north central Peru. Like the closely related *E. candida*, *E. formosa* has a wide elevational range, though this may be in part the result of cultivation by transient agriculturists.

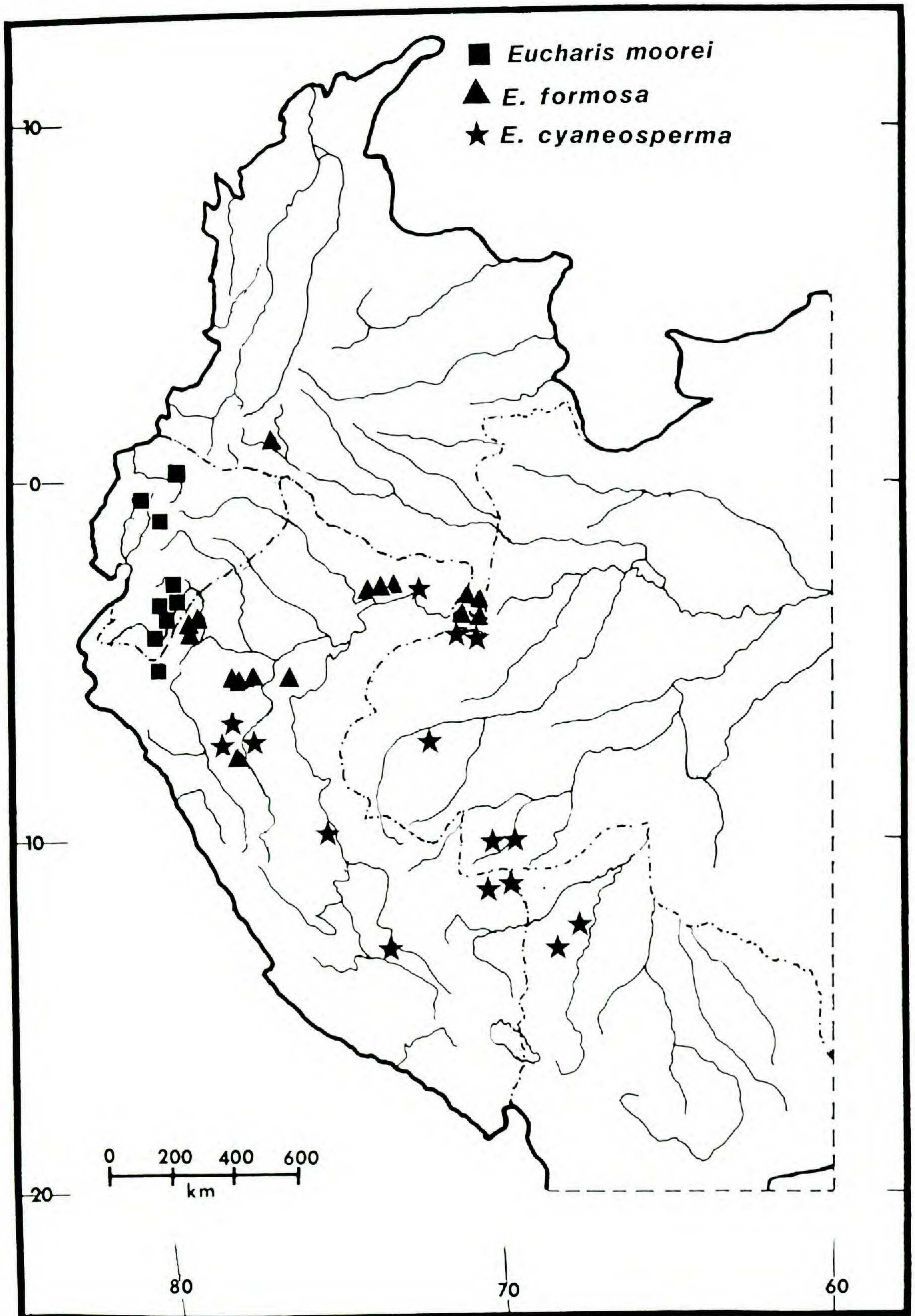


Figure 15. Distribution of *Eucharis moorei*, *E. cyaneosperma*, and *E. formosa* in northwest-central South America. See Figure 8 for Ecuadorean Populations of *E. formosa*.

Eucharis formosa is very often geographically sympatric with the smaller-flowered and less widely distributed *E. candida*. The species may be ecologically allopatric, however. Plants of *E. candida* which I collected in 1982 were growing along the bank of a small creek, just above the high water line. Populations of *E. formosa* were encountered in more upland sites. Nonetheless, in one instance two specimens (*Harling & Andersson 11719*), one each of the two species, were collected under the same number. To date, no species of *Eucharis* other than these two have been collected north of the Pastaza valley in eastern Ecuador. On the basis of herbarium study alone, Ecuadorean populations of these two taxa form a mosaic that seemed taxonomically insoluble until living material of both species from several populations was collected and flowered. Principal component analysis (Meerow 1986) supports recognition of these taxa as distinct species, and also suggest that *E. candida* and *E. formosa* have successfully hybridized in at least one area of sympatry. Nonetheless, the two entities appear phenetically distinct, and karyotype analysis (Meerow 1986) also supports the distinction between these closely related species. I believe the unprecedented degree of sympatry between these two species in Ecuador is inextricably related to their use by Indian people of the Napo and Pastaza basins. The bulbs are not only mashed for poultices, a general use to which many South American amaryllids are applied, but Indian women reportedly collect the plants quite actively for reasons they would not disclose (N. Whitten pers. comm.). Of course, aboriginal people are not without an aesthetic sense, and *Eucharis* have a pleasing aspect when in flower. Cultivation for ornamental as well as medicinal and ceremonial uses cannot be discounted. Most local inhabitants whom I met while collecting *Eucharis* in the Oriente were readily familiar with the plants when shown photographs. It is thus more than likely that both species have been transported about eastern Ecuador through human agency for years, if not centuries, perhaps even being transplanted from the wild into transient agricultural settlements. When these small gardens were abandoned after a few years, the bulbs probably recolonized locally. I am doubtful that even botanically astute native people would differentiate between such similar species as *E. candida* and *E. formosa*, and formerly allopatric populations may have been collected indiscriminently and cultivated together. Both species probably originated in the Napo-Pastaza drainage of Ecuador where present-day populations are now concentrated. *Eucharis formosa* is slightly better represented in the Pastaza valley than *E. candida*.

Eucharis formosa is larger in all parts than *E. candida*, and generally has more ovules per locule (though both species are quite variable in ovule number). The flowers of *E. formosa* emit a mild and not particularly

pleasant "sour" odor; flowers of *E. candida* are without noticeable fragrance. *Eucharis bakeriana*, a rare species from Peru, differs from *E. formosa* by its larger flowers, floral habit (perpendicular to the vertical scape axis), tube morphology (curved abruptly proximal to the ovary, then more or less straight), sweet floral fragrance, and plicate and shallowly cleft staminal cup. Karyotype and cladistic analyses indicate that *E. bakeriana* may have originated via rapid chromosomal change from sympatric populations of *E. formosa* in Peru (Meerow 1986).

Forms with toothed or edentate staminal cups occur throughout the range of *E. formosa* without any observable geographic pattern, as also occurs in *E. candida* and *E. ulei* Kränzlin (Meerow 1986). In cultivation, flowers of the same inflorescence can vary for this character. At least one Peruvian population (*Schunke 14174*) shows some karyotypic (Figures 7C, D, 13, 14) and allozyme divergence (Meerow 1986) from Ecuadorean populations. In floral morphology, however, it is indistinguishable from other collections.

ACKNOWLEDGMENTS

I thank the curators of the herbaria cited in the text who loaned material of *Eucharis* and *Phaedranassa*. Part of this work was supported by NSF Grant BSR-8401208, and by a Garden Club of America/World Wildlife Fund Fellowship in Tropical Biology. Portions of this paper are from a dissertation submitted to the Graduate School of the University of Florida in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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